



# Newsletter

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## Editor's Note

Featured on an exhibit currently displayed in the lobby of the IES Plant Science Building is a world map. Green and red map tacks spread across its span, as individuals, in pairs, and as tight clusters. The green pins mark Institute of Ecosystem Studies field sites, where staff ecologists actively are doing research. The red pins denote places where there is ongoing collaboration involving IES scientists and educators.

A number of green and red pins stand out in southwestern South America. These indicate sites of research and collaboration in Chile, both on the mainland and on the Island of Chiloé. There, Dr. Juan Armesto — a plant community ecologist and an IES adjunct associate scientist from the University of Chile — and his colleagues are studying strategies of forest management and restoration, and at the same time developing education programs to promote ecological understanding. An article about these exciting and important initiatives is on page two of this newsletter.

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## IES Ecologist Applies Newest Forest Model to Oldest Eastern Forest

by Ann Botshon

The 50,000-acre Five Ponds Wilderness Area in New York's Adirondack Mountains is the largest known tract of contiguous old-growth forest in the eastern United States. Although it has not been logged, it is changing rapidly, due to introduced diseases, acid rain and other impacts that are the indirect but widespread result of human presence.

IES ecologist Charles Canham is eager to understand the forest landscape before it is too altered for him to separate the human influences from the natural ones. That is why he feels an urgency about taking his research to Five Ponds, where he hopes to use a computer model of forest dynamics that he and his colleagues have recently developed to study entire forest landscapes.

The forest model, developed in the early 1990s by Dr. Canham, Dr. Stephen Pacala at Princeton University and Dr. John Silander at the University of Connecticut, predicts year-to-year changes of a whole forest by simulating the entire life cycle of every tree in the forest. The model analyzes the position of each tree, its supply of light, water and nutrients, and its space (hence the model's descriptive term "spatially explicit") as these factors change over time.

The current model is based on field studies conducted at the Great Mountain Forest, located on Canaan Mountain in northwest Connecticut. This is the first such model to be "calibrated" from field research specifici-

cally designed to provide the data necessary to develop an integrated model of forest dynamics. Earlier models used data drawn from previous and often disparate studies. Earlier models also omitted spatial interactions (such as realistic seed dispersal patterns) that have important effects on forest succession. Says Dr. Canham, "Our integrated field studies reveal patterns of 'tradeoffs' in ways species behave that were unknown and unanticipated."

## Expanding the Model's Uses

Dr. Canham's Connecticut work is providing insights but is limited because the Connecticut tract has a centuries-long history of human use of the land, making it impossible to separate the human impacts from effects of either natural disturbances or topographic variability. These limitations have led the ecologist to turn his attention to the Adirondacks' Five Ponds region. This last remnant of pre-settlement forest landscape in the East is spread across a rolling topography with a wide range of soils. Also contributing to the area's importance as a research site was a July 1995 windstorm that resulted in a catastrophic blowdown in the western Adirondack Mountains: 38,000 acres of forest were severely damaged (over 60% of the trees were blown down) and 109,000 acres had moderate damage (30-60% of the trees were toppled).

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Dr. Canham takes a core of the trunk, then counts the rings to learn the age of trees in his study sites.

## Forest Model, from page 1

"Five Ponds provides one of the few remaining sites in which we can study and document the dynamics of old-growth forests from the perspective of the overall landscape," Dr. Canham notes. The great size of the Five Ponds forest and its extreme diversity of topography and tree species will enable Dr. Canham to assess the relative importance of several factors that likely vary across expanses of old-growth landscape: soils, climate, topography and disturbance. He is especially interested in natural disturbances, particularly windstorms, which result in blowdowns across wide swaths of forest. "For ten or twenty years following a blowdown, surviving trees get more light, a benefit that is reflected in the tree ring record," he says, adding that, "Tree rings may be the best record of the windstorms of the last 300 years." He expects topography to influence such disturbances, and sees the

Adirondack blowdown as an extraordinary opportunity. "As an event that was remarkably variable over a fairly uniform old-growth landscape, it will help us determine how topography and storm intensity interact to determine forest composition."

The IES scientist also will be setting up a network of plots that can be used to establish the effects of soil chemistry and other variables on long-term changes in forest composition and structure. To create an inventory of the size and species of all trees, and to determine the soil types, Dr. Canham and colleagues are establishing sampling locations at 1-kilometer (0.6 mile) distances — not an easy job in an area hit hard by the 1995 blowdown. Among the researchers bracing to trek through the often impenetrable Adirondack wilderness is Ms. Erika Latty, a former IES research

assistant now a doctoral candidate at Cornell University. In addition, Dr. Canham will rely on computer Geographic Information Systems (GIS) to help determine the effects of topography on wind exposure and soil moisture. Mr. Mike Papaik, a consultant, will be setting up the GIS and overseeing the 1996 field work.

Dr. Canham believes this project could be an opportunity for other investigators to piggyback with his research, particularly biologists who inventory species diversity. Looking to the future, he reflects, "With a base camp in Five Ponds, we could bring in specialists and thoroughly document the biodiversity of this old growth landscape."

## Senda Darwin: Saving the Ecosystems of Chiloé

In 1834, when the *Beagle* arrived at Chiloé off the coast of Chile, Charles Darwin wrote:

*The island is about ninety miles long, with a breadth of rather less than thirty. The land is hilly, and is covered by one great forest, except where a few green patches have been cleared round the thatched cottages. From a distance the view somewhat resembles that of Tierra del Fuego; but the woods, when seen nearer, are incomparably more beautiful (with) many kinds of fine evergreen trees, and plants with a tropical character ...*

from: *The Voyage of the 'Beagle'*  
by Charles Darwin, first published in 1845

Over the past 50-100 years, while forests in the southern part of Chiloé remain much as Darwin found them, forests in the northern part of the island have declined through the effects of expanding agriculture and deforestation around human settlements. In fact, temperate rainforests throughout southern Chile are threatened by deforestation, species loss, and replacement of native species by monocultures of exotic trees for commercial forestry. In response, a group of Chilean and international ecologists has formed the Institute of Ecological Research-Chiloé (IER-Chiloé) to do research on local and regional environmental problems and to communicate scientific findings to the public.

Chilean and international scientists — among them ecologists from IES — have

been doing research in Chiloé for several years, including studies of how old-growth forests acquire and store their nutrients and how endemic forest birds survive in fragmented landscapes. Therefore, there is already a substantial amount of scientific data about the region. IER-Chiloé has obtained a parcel of land to establish a biological station, and because sections of the road traveled by Darwin cross the property, the station is called "Senda Darwin" (Darwin's Trail).

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*A road leads to Senda Darwin, but it is passable only when the river level is low. Therefore, the main entrance to the station, especially in rainy weather, is across this wooden bridge.*



*Senda Darwin research station, Chiloé, Chile.*

# Acid Rain Damage Is More Serious Than Predicted

Dr. Gene E. Likens, Director of the Institute of Ecosystem Studies, and colleagues Dr. Charles T. Driscoll of Syracuse University and Mr. Donald C. Buso, an IES research assistant, reported in the 12 April 1996 issue of *Science* that effects of acid rain on forest ecosystems in the northeastern United States are much more serious than previously thought. In their report, which was featured in the 16 April issue of *The New York Times' Science Times*, they explain how the effects of acid rain have led to the loss of large quantities of soil nutrients, potentially resulting in a dramatic decline in the growth rate of plants, in spite of the reduction in sulfur dioxide emissions following passage of the Clean Air Act in 1970 and Amendments in 1990.

The three scientists report results of long-term research at the Hubbard Brook Experimental Forest in New Hampshire's White Mountains, where soil and stream-water chemistry have been measured continuously since 1963. These represent the longest continuous records of this type in North America. The authors address the questions: Will forest and aquatic ecosystems recover from the effects of acid rain, and if so, at what rate?

Acid rain, or more accurately acid precipi-

tation (sleet, snow and cloudwater also can be acidic), results primarily from the emission of sulfur and nitrogen compounds during the burning of fossil fuels by electricity-generating facilities, industrial processes, highway vehicles etc. Natural sources of sulfur compounds account for less than 10% of the total input of this pollutant to the atmosphere. Acid rain is thought to have begun in the northeastern United States in the early 1950s, intensifying through the 1950s and 1960s. Acid rain and the dry deposition of acidic compounds can acidify streams, lakes and soils, and can change the composition and function of animal, plant and microbial populations and communities.

The Clean Air Act, passed by the U.S. Congress in 1970, mandated controls that reduced atmospheric emissions of pollutants. Additional reductions in emissions and concomitant decreases in wet and dry deposition of strong acids are expected as a result of the 1990 Amendments to this Act. However, in their paper in *Science*, "Long-term effects of acid rain: response and recovery of a forest ecosystem", Dr. Likens and co-authors describe how continuous data from over 30 years of research suggest that forest ecosystems are much more vulnerable to the cumulative deposition of

strong acids than expected because large amounts of base cations (primarily calcium and magnesium that are necessary for plant growth) have been leached from the soil by acid rain. Because their ability to neutralize acids has been reduced, surface waters and forest soils in the northeastern United States are recovering very slowly from the effects of acid precipitation. Moreover, the scientists conclude that the recent Amendments to the Clean Air Act will not provide enough reduction in pollutant emissions to protect sensitive forest and aquatic ecosystems like those found in the northeastern United States.

\* \* \* \* \*

In 1963, Dr. Likens and three scientific colleagues developed the Hubbard Brook Ecosystem Study in the Hubbard Brook Experimental Forest, West Thornton, New Hampshire. Now, over 30 years later, this area is one of the most intensely studied places on Earth. Dr. Likens continues to be involved actively in research there: for example, the November - December 1995 issue of the IES NEWSLETTER describes one of his projects, to determine potential environmental effects of the chemicals that are replacing chloro-fluorocarbons.

## Senda Darwin, *continued*

Senda Darwin is open to scientists studying the ecology of southern South America, and it serves another very important function as well. Recognizing that appreciation and protection of the environment grow from knowledge and understanding, Senda Darwin founders — among them IES adjunct associate scientist Dr. Juan Armesto (University of Chile, Santiago) — are developing education programs for Island residents and tourists. These programs include local natural history and ecology courses and activities for school teachers, students and park guards; plantings of native tree species in schoolyards and public areas; development of a tree nursery to support future ecological restoration programs in Chiloé; and construction of a botanical garden displaying each major forest type of temperate South America.

A non-profit foundation has recently been established in Chile to help accomplish the goals of Senda Darwin. For information on how to collaborate with this initiative, Dr. Armesto invites readers to contact him at his e-mail address:

jarmesto@abello.dic.uchile.cl

## Special Program Promotes Collaboration

Since fall 1993, under the auspices of the Director's Program for Visiting Distinguished Scientists, the Institute has sponsored week-long visits by six eminent ecologists from around the United States. These visiting investigators meet individually with members of the research and education staff to share ideas, compare findings and plan collaborative work. In addition, each presents a lecture as part of the Institute's free public scientific seminar series.

In February, the program brought Dr. Deborah B. Jensen (above right, with Dr. Likens) to the Institute. As vice president of the Conservation Science Section of The Nature Conservancy, Dr. Jensen is responsible for all scientific activities of the organization's domestic and international programs. In addition to a full schedule of meetings with Institute ecologists, she lead a staff discussion about "Is Conservation Biology Advocacy?" and presented a public seminar on "Conservation Priority Setting: Designing an Ecoregional Portfolio".



MOLLY AHEARN

Funding for the Director's Program for Visiting Distinguished Scientists comes from The Merrill Lynch & Co. Foundation, Inc.

*Note: Another IES Visiting Distinguished Scientist was Dr. Mary F. Willson, who spent a week at the Institute in September 1995. Dr. Willson, at the Forest Sciences Laboratory in Juneau, Alaska, is international coordinator of IER-Chiloé and spends part of each year studying the conservation status of species of forest birds on the Island of Chiloé (see the article beginning on page 2).*

## Calendar

### CONTINUING EDUCATION

Call the Continuing Education Program office at 914/677-9643 for information on spring semester classes, workshops and excursions. Late spring programs include:

#### Landscape Design

June 8: Designing for Low Maintenance

#### Gardening

June 9: The Healthy Organic Garden

June 15 (3 sessions): Field Course: Small-Scale Organic Vegetable Production

June 22: Designing a Perennial Garden for All Seasons (*FULL*)

June 22 & 23: Fern Identification and Propagation

#### Natural Science Illustration

June 4 - 8: Pen and Ink II: Plant Illustration

June 3 - 7: Colored Pencil Illustration

#### Excursions & Tours

June 8: A Country Garden at Antinore and The Shaker Museum

June 9: Planting Fields Arboretum and Old Westbury Gardens

June 22: Brooklyn Botanic Garden

June 24: An Early Summer Tour of Stonecrop

Summer semester catalogues are available at the Gifford House. Programs will include:

- Color Relationships in Illustration and the Garden
- Container Gardening
- Fundamentals of Gardening
- Summer Wild Plant Identification
- Landscape Design for the Small Residential Site
- Quick Sketching for Landscape Design
- Putting Together Your Portfolio
- Drawing in the Garden
- Developing a Naturalist's Notebook
- The Spineless Inhabitants of Flowing Water
- Excursion to Duck Hill and The Hammond Museum Japanese Stroll Garden

### SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of the month, except over holiday weekends. Call 914/677-5359 to confirm the day's topic or, in case of poor weather, to learn the status of the day's program. Programs begin at 2 p.m. at the Gifford House:

Call 914/677-5359 to see if programs have been scheduled for July and August.

\* We strongly recommend that participants wear long pants tucked into socks and sturdy waterproof footwear for all outdoor programs.

### IES SEMINARS

From mid-September through mid-May, scientific seminars are held each Friday at 3:30 p.m. at the IES Auditorium. Seminars are free, and the public is invited to attend.

### VOLUNTEER OPPORTUNITIES

Volunteers are needed to work with Gifford House Visitor and Education Program staff at the visitor reception desk on weekends, in the IES Plant Shop and as part of the mailing crew. To learn the responsibilities and benefits, call Ms. Su Marcy at 914/677-5359.

### GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 3:30 p.m. daily except public holidays. Admission is by free permit (see "HOURS").

### IES GIFT AND PLANT SHOP

New in the Shop ... flower presses ... beeswax candles ... books of local interest, including the newly released *Gardens of the Hudson River Valley* ... for children ... bird feeders ... birdhouse kits

• Gift Certificates are available •

Senior Citizens Days: 10% off on Wednesdays

### HOURS

Summer hours: May 1 - September 30  
Closed on public holidays.

Public attractions are open Mon. - Sat., 9 a.m. - 6 p.m. & Sun. 1 - 6 p.m., with a free permit\*. (Note: The Greenhouse closes daily at 3:30 p.m.) The IES Gift and Plant Shop is open Mon.- Sat., 11 a.m. - 5 p.m. & Sun. 1 - 5 p.m. (The shop is closed weekdays from 1 - 1:30 p.m.)

\* Free permits are required for visitors and are available at the Gift Shop daily until 5 p.m.

### MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include a member's rate for courses & excursions, a 10% discount on Gift Shop purchases, a free subscription to the newsletter and participation in a reciprocal admissions program. Individual membership: \$30; family membership: \$40. Call Ms. Janice Claiborne at 914/677-5343.

The Institute's Aldo Leopold Society  
In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call Ms. Jan Mittan at 914/677-5343.

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